CONCEPT DESIGN
DRAFT CLOSURE PLAN
HAZARDOUS WASTE CONTAINMENT/CLEANUP
OMC - WAUKEGAN HARBOR
WAUKEGAN, ILLINOIS

Contract No. DACW 45-85-C-0023

Prepared By:

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For:

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Omaha, Nebraska

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CLOSURE PLAN

I. INTRODUCTION

A. Purpose and Scope

The purpose of this Plan is to facilitate closure activities to ensure that closure is done in a manner that minimizes the need for maintenance and controls and minimizes or eliminates post-closure escape of hazardous matter. Procedures are established for monitoring of the containments and for reporting of any detected leakage.

This Plan includes a Closure Plan and Post-Closure Plan for the Hazardous Waste Containment/Clean-up, OMC-Waukegan Harbor, Waukegan, Illinois. A copy must be kept at the facility until the project is completed and certified. Also to be maintained at the site is a map showing exact location, dimensions, depths and contents of each containment cell and the approximate location of hazardous waste within.

The format of this report is based on requirements as outlined in Resource Conservation and Recovery Act (RCRA) and 40 CFR, Part 264, Subparts F, G and N and includes information available at the concept design stage of the project.

The Closure Plan has been developed based on the "Conceptual Design, OMC Hazardous Waste Site, Waukegan, Illinois" as prepared by CH_2M HILL.

The Conceptual Design submittal consists of the following documents:

1. Design drawings
2. Design Analysis, including cost of specifications
3. Conceptual cost estimate
4. Draft Site-Specific Quality Management Plan
5. Draft Site-Specific Safety Plan, and
6. Draft Site Closure Plan

All of these documents are required for project review, development and operation.

B. General Description

The Outboard Marine Corporation (OMC) site is located on Sea Horse Drive and the west shore of Lake Michigan in Waukegan, Illinois. Polychlorinated biphenyls (PCBs) have been found in Waukegan Harbor and in the North Ditch/ Parking Lot Area. OMC outfalls are located in Slip No. 3 and the Crescent Ditch.

Waukegan Harbor was divided into three areas of contamination:

1. Slip No. 3 - PCB concentrations in excess of 500 ppm
2. Upper Harbor - PCB concentrations from 50-500 ppm
3. Lower Harbor - PCB concentrations from 10-50 ppm

The North Ditch area includes the Crescent Ditch, Oval Lagoon and the east-west portion of the North Ditch. The levels of contamination are 5,000 to 38,000 ppm, 26,000 ppm, and above 5,000 ppm, respectively.

The Parking Lot Area is located north of OMC's Plant No. 2. PCB concentrations are in excess of 5,000 ppm. The southwest corner has concentrations ranging from 50 to 5,000 ppm.

Actions were development to clean up and contain the PCB-contaminated soils. These actions are briefly described in the next section.

The USEPA's clean-up plan consists of five actions:

Action 1: The western portion of Slip No. 3 will be dredged and the contaminated materials will be transported off-site.

Action 2: The remaining portion of Slip No. 3 and the Upper Harbor will be dredged, Areas B and C, respectively. Area B materials will be removed, dewatered, fixed and disposed of in the Parking Lot Area. Area C sediment will be removed, dewatered and disposed of in the Parking Lot Area.

Action 3: Contaminated soil will be excavated from the Crescent Ditch and the Oval Lagoon and will be disposed of off-site.

Action 4: The east-west portion of the North Ditch will be excavated to install a bypass drainage pipe. The excavated soil will be disposed of in one of the containment cells. The Crescent Ditch/Oval Lagoon area will be enclosed by a slurry wall and capped.

Action 5: The Parking Lot Area will be enclosed by a slurry wall and will contain contaminated soil. The containment cell will be capped.

II. CLOSURE

A. General

1. Requirements

Within 90 days after placement of the final volume of contaminated material, the operator must treat, remove, or dispose of all hazardous waste and closure must be completed within 180 days.

The Closure Plan includes a description of how and when the facility will be closed including placement of final surfaces, abandonment of temporary wells, monitoring requirements, and restoration of treatment areas. An estimate of the maximum inventory in storage and in treatment, quantities needed for closure, decontamination and removal steps, and a Construction Schedule are also included.

The closure cover material should minimize migration through the system, function with minimal maintenance, promote drainage, minimize erosion, and accommodate settling and subsidence. All equipment/structures must be decontaminated or disposed of before removal from the contamination zones. Specific requirements for decontamination procedures are described in Appendix H of the Design Analysis. All temporary wells must be properly abandoned. During construction and closure activities, groundwater quality must be monitored at least semi-annually at each well.

Specific requirements per area will follow subsequently.

2. Reporting/Recordkeeping

At least 180 days prior to the date that closure is expected to begin, the U.S. Environmental Protection Agency (USEPA) Regional Administrator shall be notified. Within 90 days after closure activities are completed, a closure report including a survey plat showing location and dimensions of landfill cells and a record of type, location, and quantity of hazardous waste disposed of in each cell, must be submitted to the zoning authority and Regional Administrator. The Closure Report will be prepared in accordance with USEPA and Resource Conservation and Recovery Act (RCRA) requirements. Notice in the deed to the property must warn potential purchasers that the land was used for storage of hazardous waste, that use of the land is restricted, and that a plat and descriptive record is filed with the zoning authority.

B. Area A: West End of Slip #3

1. Location

Area A constitutes the western portion of Slip #3 as shown on Sheet No. 006. Activities in the area include cofferdam installation and clamshell dredging of surface sediments and deep contaminated sand and silt.

2. Closure Requirements

a. Final Surfaces

After completion of dredging, the deep excavation shall be backfilled. Backfill will be a granular material, Gradation No. CA18 as specified in the Illinois DOT Standard specifications for Road and Bridge Construction (1973), p. 546. An alternate would be CA6 with P200≤5%. The material will be placed using the clamshell bucket. See the Design Analysis for further discussion of material and method of placement.

b. Equipment/Structure Removal and Decontamination

Upon completion of dredging activities, the sediment dispersal control devise and the cofferdam shall be removed and decontaminated or disposed of at a chemical waste landfill. All equipment used in Area A, i.e. the clamshell dredge, transportation trucks, shall be decontaminated before removal from the contaminated area.

c. Monitoring

Monitoring in the harbor during and after construction is addressed in the Site Specific Quality Management Plan.

3. Schedule of Events

The removal and decontamination activities will occur as shown on the detailed Construction Schedule in Appendix A. In summary, the clamshell dredge will be decontaminated in July, 1986; the cofferdam will be removed and decontaminated in July, 1986; and the Sediment Dispersal Control Device will be removed and decontaminated in August, 1986.

4. Quantities

The dredging limits were selected to remove materials containing PCB concentrations above 50 ppm.

The volume of granular material needed to backfill the excavated area is 3,923 cy. Refer to the Design Analysis for volume calculations.

C. Areas B and C: East End of Slip #3 and Waukegan Harbor

1. Location

Area B constitutes the remaining portion of Slip #3 and Area C is the upper Waukegan harbor. Refer to Sheet No. 006 for locations. The activities occurring in these areas include installation of a sediment dispersal control device, hydraulic dredging of approximately 39,300 cubic yards of in-place soft sediment, and pumping of the slurry to the storage lagoons.

2. Closure Requirements

a. Final Surfaces

Final surfaces of this area will be the top of sand layer after the soft sediment has been removed. Refer to Sheet No. 027 for final grades of the harbor area.

b. Equipment/Structure Removal and Decontamination

Upon completion of dredging in Areas B and C, the hydraulic dredge shall be decontaminated. The Sediment Dispersal Control Device shall be removed and decontaminated or disposed of at a chemical waste landfill.

c. Monitoring

Water and sediment monitoring on the harbor, during and after dredging activities, are discussed in the Site Specific Quality Management Plan.

3. Schedule of Events

The Sediment Dispersal Control Device will be removed in September, 1986 and the dredge will be decontaminated concurrently. For the detailed construction schedule, refer to Appendix A.

4. Quantities

Dredging of the soft sediment is intended to remove materials containing PCB concentrations above 50 ppb.

D. North Ditch Bypass Area

1. Location

The North Ditch Bypass Area runs north from an existing culvert near the west property edge to the northwest corner and east-west along the northern edge of the property. Activities within this area include excavation and backfill of the east-west portion of the North Ditch and construction of the bypass. Refer to Sheet No. 005 for the general location.

2. Closure Requirements

a. Final Surfaces

On completion of the bypass, a clay cap will be installed to inhibit leaching of PCBs from the uncontained contaminated soil. Final surfaces shall be topsoiled, seeded, fertilized and mulched. Clay depth shall be 2 feet, compacted to 90% Modified Proctor or, alternatively, 95% Standard Proctor. Topsoil thickness shall be 6 inches. The seed mix used shall be Class I per Illinois DOT Standard Specifications for Road and Bridge Construction (1973). Application rates are as listed below. An appropriate fertilizer will be determined from the analysis of the topsoil and will be applied at a specified rate. Upon completion of seeding, the area will be mulched for moisture retention. Mulch will consist of any hay or straw in an air-dry condition and free of noxious weed seeds or other matter.

TABLE 1

CLASS I SEED MIX APPLICATION RATES

Kentucky Bluegrass	50 lbs/acre
Creeping Red Fescue	10 lbs/acre
Perennial Ryegrass	20 lbs/acre
White Clover	5 lbs/acre

The bypass outlet will be protected from erosion with a poured in place, reinforced concrete headwall.

b. Equipment/Structure Removal and Decontamination

Upon completion of the earthwork, all equipment used will be decontaminated before leaving the area.

c. Monitoring

Two new groundwater monitoring wells in the central portion of this area shall be monitored for PCB migration at least semi-annually throughout closure. Refer to Table 2 and Sheet No. 427 for well locations and depths.

3. Schedule of Events

Final surface closure activities shall occur after June, 1986, and decontamination of equipment shall occur after those activities in which they are used spanning a time period from May through August, 1986. For the detailed Construction Schedule, refer to Appendix A.

4. Quantities

Based on a clay thickness of 2 feet, an estimate of 8,900 cy of clay will be needed. An estimate of 2,380 cubic yards of topsoil will be needed based on a depth of 6 inches. An area of 128,500 square feet will be seeded, fertilized and mulched.

E. Waste Treatment and Storage Area

1. Location

The Waste Treatment Area consists of the vacant OMC property to the east of the Upper Waukegan Harbor (Area C) as shown on Sheet No. 202. This includes the dewatering lagoons, curing cells, batch plant and water treatment plant.

2. Closure Requirements

a. Final Surfaces

When treatment/storage facilities are no longer operational and upon removal of the dewatering lagoons, final surfaces will be regraded to nominal slopes for drainage.

b. Equipment/Structure Removal and Decontamination

After all fixing has been completed, the Batch Plant shall be removed and decontaminated. After the dewatering activities have been done, the Water Treatment Plant shall be removed and decontaminated. Upon completion of curing fixed solids, the curing cell shall be removed. This includes disposal of the contaminated materials in the Parking Lot area and the removal of excess clean materials from the site. Upon completion of dewatering, the dewatering lagoons shall be removed. This consists of the disposal of contaminated materials in the Parking Lot Area and the removal of excess clean materials from the site.

c. Monitoring

Temporary monitoring wells in this area shall be properly abandoned. Abandonment includes removal of the above-surface portion of the pipe, backfilling with bentonite-cement grout and topsoiling to grade. See Appendix E for exact procedures for well abandonment. However, if groundwater monitoring prior to closure reveals groundwater contamination, these temporary wells shall continue to be monitored until it is assessed that they are no longer necessary. For location of wells, refer to Table 2 and Sheet No. 027.

3. Schedule of Events

For the detailed Construction Schedule, refer to Appendix A. In summary, the final surface closure activities will occur in November, 1988. The Batch Plant shall be removed and decontaminated in September, 1986. The Treatment Plant shall be removed during October and November, 1988 and the curing cells shall be dismantled during closure of the lagoons. Well abandonment will occur in November, 1988 if no contamination has occurred.

4. Quantities

In addition to removing the dredged material from the lagoons and the fixed solids from the curing cells, the lagoon liner system will be contaminated and much be removed. As a minimum, the top clay liner, consisting of 26,500 cy of material will be removed and placed in the parking lot containment cell.

If the underdrain system has become contaminated, approximately 26,500 cy of granular material and associated piping, and 26,500 cy of base clay liner must be removed to the parking lot containment cell. Approximately 123,000 cy of imported clean fill will be taken from the site prior to final grading.

F. Crescent Ditch/Oval Lagoon Containment Area

1. Location

The Crescent Ditch/Oval Lagoon Containment area is located in the northwest portion of the property. Activities in this area include construction of braced excavation systems, excavation of contaminated soil, backfilling, and off-site disposal.

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TABLE 2

MONITORING WELL LOCATIONS

PROPOSED WELLS	LOCATIONS
Install During Initial Construction	More exact locations will be determined for final design. For now, see the following sheets in the drawing set:
Crescent Ditch/Oval Lagoon Containment Area	Sheet No. 329
MW-1	
MW-2	
MW-3	
MW-4	
MW-5	
MW-6	
MW-7	
MW-8	
MW-9	
MW-10	
Central Portion of the Bypass Ditch	Sheet No. 432
MW-11	
MW-12	
Parking Lot Containment Area	Sheet No. 536
MW-13	
MW-14	
MW-15	
MW-16	
MW-17	
MW-18	
MW-19	
MW-20	
MW-21	
MW-22	

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TABLE 2
(continued)

MONITORING WELL LOCATIONS

TEMPORARY WELLS	LOCATIONS
Install During Initial Construction	
Waste Storage/Treatment Area	Sheet No. 027
TW-1	
TW-2	
TW-3	
TW-4	
TW-5	
TW-6	
TW-7	
TW-8	
TW-9	

INTERNAL WELLS	LOCATIONS
Install During Closure	
Crescent Ditch/Oval Lagoon	Sheet No. 329
WW-1	
WW-2	
WW-3	
Parking Lot Containment Area	Sheet No. 536
WW-4	
WW-5	
WW-6	
WW-7	

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The containment cell will be enclosed within a slurry wall and will have a capped area of 144,800 square feet. Approximately 1,200 cubic yards of PCB-contaminated soil will be contained. The average depth of the containment cell will be 5 feet. Refer to Sheet No. 005 for location of the containment area.

2. Closure Requirements

a. Final Surfaces

Upon completion of the containment area, a final surface consisting of 2 feet of clay, a synthetic membrane, 6 inches of sand, 8 inches of crushed aggregate, and 4 inches of bituminuous pavement will be constructed. The effect of PCBs on this clay cap and the slurry wall should be investigated; however, it is not included in the scope of this contract.

The final surface will slope at 1.5% for drainage purposes over the parking area. The 340 feet of railroad that was removed during construction will be reconstructed to the same lines and grades. A geotextile will be installed to separate the ballast of the rail spur from the underlying final cover.

Clay for final cover shall meet the following specifications:

- Percent P200 $\geq$ 50%
- Percent Clay $\geq$ 25%
- Maximum Permeability $\leq 1 \times 10^{-7}$ cm/sec
- Liquid Limit $\geq$ 30%
- Plasticity Index $\geq$ 15%
- Compaction $\geq$ 90% Modified Proctor

The synthetic membrane will be 40 mil High Density Polyethylene (HDPE). Refer to the Design Analysis, Section VIII.

The sand gradation shall be specified such that it will be classified as "SP", but still satisfy filter requirements described by RCRA. The permeability shall be greater than or equal to 1×10^{-3} cm/sec. Refer to the Design Analysis, Section VIII.

Crushed aggregate will be in accordance with Illinois DOT specifications, Section 301.

Bituminous binder and surface courses will be in accordance with Illinois DOT specification, Section 406.

The railroad ballast material shall be 3/4" to 1-1/2" crushed stone. The geotextile will be further discussed for final design.

After completion of the final surfaces, internal wells for monitoring groundwater elevation and pressure vents will be installed. See Table 2 for locations.

b. Equipment/Structure Removal and Decontamination

Upon completion of the earthwork, all equipment, i.e. backhoes, braced excavation system, slurry wall construction equipment and equipment used to cap the facility, will be decontaminated before leaving the site. Finally, when all activities are completed, the security fence shall be decontaminated and the decontamination facility shall be removed.

c. Monitoring

During closure, groundwater monitoring shall continue in order to detect PCB migration. Monitoring will occur at least semi-annually throughout the closure period. Refer to Table 2 for well locations.

3. Schedule of Events

Construction of the final surface, interior wells, and pressure vents will occur in October, 1986 and subsequently all equipment will be decontaminated before removal from the area. The Braced Excavation system will be removed and decontaminated in September, 1986. After all activities are completed, the decontamination facility shall be removed. For the detailed Construction Schedule, refer to Appendix A.

4. Quantities

a. Quantities in Storage

In addition to the contaminated material left in place, approximately 1,200 cy of contaminated material will be contained in this containment cell. The material will consist of material excavated for the construction of the slurry wall.

b. Quantities Needed for Closure Activities

Refer to Table 3 below for quantities needed for closure activities. See the Design Analysis for generation of all quantities and further discussion of items.

TABLE 3

CLOSURE QUANTITIES
CRESCENT DITCH/OVAL LAGOON AREA

Clay	10,700 cy
Synthetic Membrane	144,800 sf
Sand	2,700 cy
Crushed Aggregate	3,600 cy
Bituminous Pavement	1,800 cy
Ballast (3/4"-1 1/2" Crushed Stone)	200 cy

G. Parking Lot Containment Area

1. Location

The Parking Lot Containment Area is in the northeast section of the property. The area will be enclosed within a slurry wall and will have a capped area of approximately 179,100 square feet. The average depth of the cell is 18 feet. Refer to Sheet No. 528 for more precise location and dimensions of the containment cell.

2. Closure Requirements

a. Final Surfaces

Upon completion of filling activities, the final surface shall be constructed. The plateau area of the parking lot will slope at 1.5% for drainage. The side slopes are at a 3 to 1 slope and the entrance/exit ramps slope at approximately 7%. The high elevation is 604 and the low is 600. Final surface will consist of 2 feet of clay, a synthetic membrane, 6 inches of sand, 8 inches of crushed aggregate, and 4 inches of bituminous pavement. The

sideslopes will have one foot of clay, a synthetic membrane, one foot of clay, a geotextile, and riprap. All sideslopes will have one foot of riprap and the shoreline side will have an additional 18 inches of large riprap.

The clay, synthetic membrane, sand, aggregate and bituminous material for final cover will be as specified under final cover for the Crescent Ditch/ Oval Lagoon area, Section F of this plan. The geotextile shall be a 5-ounce fabric. A detailed specification will be developed for final design. The small riprap shall consist of a 12-inch thick layer of approximate gradation 1 to 6 inches. The large riprap for the shoreline side will be quarrystone, approximate gradation of 9 to 18 inches.

The effect of PCBs on the clay and slurry wall should be analyzed; however, that analysis is not within this contract. After completion of the final surface, internal wells for monitoring internal groundwater levels and pressure vents will be installed. Refer to Table 2 and Sheet No. 536 for locations.

b. Equipment/Structure Removal and Decontamination

All equipment involved in the construction, transportation and compaction of soil or used for final surface construction shall be decontaminated before leaving the contamination zone. Upon completion, the decontamination facility and water treatment plant shall be removed.

c. Monitoring

During closure, monitoring shall continue in order to detect PCB migration. Monitoring shall be done at least semi-annually throughout the closure period. Refer to Table 2 for well locations.

3. Schedule of Events

Construction of final surface, interior wells and pressure vents shall be performed starting in September, 1988. Subsequently, all equipment used for construction will be decontaminated before leaving the area. And finally, the decontamination facility will be removed. For the detailed Construction Schedule, refer to Appendix A.

4. Quantities

a. Quantities in Storage

In addition to the existing in-place contaminated material being contained in the slurry wall, approximately 112,300 cubic yards of contaminated soil will be placed as fill material. Table 4 delineates the quantities and sources contributing to this total storage volume.

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TABLE 4

STORAGE QUANTITIES BY SOURCE
PARKING LOT CONTAINMENT CELL

Central Slip No. 3 (1,000 cy x 1.20 for batching)	1,200 cy
Eastern Slip No. 3 and Upper Harbor (38,300 cy @ 40% Solids)	23,000 cy
East-West Portion of North Ditch	4,000 cy
Lagoon Liner	21,000 cy
Volatilization Control Sludge - Lagoon 1	1,300 cy
Lagoon Soil/Cement	10,500 cy
Curing Cell Liner	2,800 cy
Curing Cell Soil/Cement	1,400 cy
Fixation Area Liner	2,800 cy
Fixation Area Soil/Cement	1,400 cy
Slurry Wall Excavation (Crescent Ditch/Oval Lagoon)	5,200 cy
Slurry Wall Excavation (Parking Lot Area)	7,300 cy
Contaminated Paving - Treatment Area	1,000 cy
Contaminated Paving - Parking Area	1,700 cy
Berm Volumes - Parking Area	4,000 cy
	88,600 cy

Capacity of the cell is 112,300 cy. At concept, 88,600 cy will be contained. For Final Design, containment volumes may change and final grades will be adjusted up or down to accommodate new final volumes.

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TABLE 5

CLOSURE QUANTITIES
PARKING LOT CONTAINMENT AREA

PLATEAU AREA

Clay	13,300 cy
Synthetic Membrane	179,100 sf
Sand	3,300 cy
Crushed Aggregate	4,400 cy
Bituminous Material	2,200 cy

SIDESLOPES

Clay	8,000 cy
Synthetic Membrane	107,900 sf
Geotextile	107,900 sf
Riprap (fine)	4,000 cy
Riprap (large)	2,000 cy

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III. POST-CLOSURE

A. General

After completion of all construction activities, the areas containing PCBs will be considered closed. These areas are the North Ditch Area, the Crescent Ditch/Oval Lagoon Area and the Parking Lot Aera. These areas will require continuing care. Post-closure for the initial 30 years after closure shall consist of monitoring and maintenance activities. A post-closure plan follows that identifies activities to be carried on after closure and the frequency of these activities. Also included in Appendix B is a list of persons to contact regarding the site. An updated post-closure plan must be kept by the contacts listed.

1. Groundwater Monitoring Activities

a. General Requirements and Well Installation Procedures

The monitoring system must consist of a number of wells at locations and depths to render samples from the uppermost aquifer that represent both quality of water not affected by the site and the quality of water passing the point of compliance. Monitoring must be conducted to:

- measure hazardous constituents (PCB's) accurately,
- determine groundwater surface elevations each time wells are sampled, and
- establish a background quality value.

For background quality identification, a minimum of one sample for each well and a minimum of four samples for the entire system must be collected and analyzed prior to major construction activities.

Well installation procedures are included in Appendix C, and techniques for sample collection, preservation, shipment, analytical procedures, and chain-of-custody control are included in Appendix D. All wells must be cased, either screened or perforated, and packed with gravel or sand. The annular space above the sampling depth must be sealed to prevent contamination.

b. Detection Monitoring Program

The detection monitoring program must establish background quality, groundwater quality at each well at the compliance point, and the groundwater flow rate and direction in the uppermost aquifer. Groundwater quality must be determined at least semi-annually during the post-closure period. Flow rate and direction shall be determined at least annually.

c. Compliance Monitoring Program

The compliance monitoring program must establish groundwater quality at each well at the compliance point and the groundwater flow rate and direction in the uppermost aquifer. Groundwater quality must be established at least quarterly during the compliance period and flow information must be determined at least annually.

d. Reporting

1) Detection Monitoring Program

If an increase in the concentration of contaminant occurs (greater than 25% of that determined as the background level of the well) for more than two consecutive sampling periods, the owner/operator must:

1. Notify the Regional Administrator in writing within 7 days,
2. Sample groundwater in all wells,
3. Establish a background quality value,
4. Within 90 days, submit an application for permit modification, including the concentration found and any proposed changes to the groundwater monitoring system, frequency, sampling or analysis procedures, and
5. Within 180 days, submit to the Regional Administrator the data necessary to justify any variance and submit the engineering Feasibility Plan for corrective actions.

If it can be demonstrated that another source caused the increase or if the increase was due to an error in sampling, analysis or the evaluation procedures, a report to this effect shall be submitted within 90 days of detection to the Regional Administrator.

If the detection monitoring program is at any time insufficient, an application to modify the program should be submitted within 90 days.

2) Compliance Monitoring Program

If elevated levels of PCBs are detected at any well, the owner/operator must:

1. Notify Regional Administrator within 7 days, and
2. Submit an application for a permit modification to establish a corrective action program (within 180 days or within 90 days if the Feasibility Study was previously submitted).

If it can be shown that another source caused the migration of PCBs or that it resulted from an error in sampling, analysis or evaluation, then a report to this effect must be submitted within 90 days of detection.

If the compliance monitoring program is at any time insufficient, an application to modify this program should be submitted within 90 days.

e. Corrective Action Program

In the event that migration of PCBs is occurring in excess to background conditions, a corrective action program should be implemented. The program shall prevent hazardous constituents from migrating out of the containment cells by removal, treatment or containment. A monitoring program must be introduced to show the effectiveness of the corrective action.

2. Maintenance Activities

a. General Requirements

Maintenance activities and frequencies should ensure the integrity of final surfaces, slurry walls and the functioning of the leak detection system. Also, as part of maintenance, all benchmarks and control monuments should be protected and maintained.

b. Reporting

If liquid levels in any of the internal wells increases above the levels of the groundwater in external wells during the post-closure care period, the owner/operator must notify the Regional Administrator in writing within seven days after detection.

B. North Ditch Bypass Area

1. Groundwater Monitoring

In the central portion of the North Ditch are two groundwater monitoring wells. Refer to Sheet No. 427 and Table 2 for specific locations. Monitoring to determine background quality, groundwater surface elevation, and PCB migration should be performed. Wells should be monitored quarterly for PCB migration and groundwater surface elevation. Flow rate and direction shall be determined annually.

2. Inspections and Maintenance

Periodic inspections of the final surface and the groundwater monitoring wells shall be conducted to ensure the integrity and effectiveness of each.

Quarterly inspections of the final surfaces shall be done for the first five years to locate any settlement or erosion problems. If any problems occur, the area should be regraded and reseeded to establish the vegetative cover. After the initial five years, inspections shall be done annually.

The monitoring wells shall be inspected quarterly for the first five years to determine if they are functioning properly. After the initial five-year period, inspections should be done annually.

C. Waste Treatment and Storage Area

1. Groundwater Monitoring

Groundwater monitoring wells in this area are to be abandoned using procedures in Appendix E during the closure period. No long-term monitoring shall be performed.

2. Inspections and Maintenance

No long-term care inspections will be needed in this area due to probable land use and quality of materials within this area.

D. Crescent Ditch/Oval Lagoon Containment Area

1. Groundwater Monitoring

The ten monitoring wells in this area shall be monitored for PCB migration, groundwater surface elevation, and flow rate and direction. See Sheet No. 329 and Table 2 for well locations. Wells should be monitored quarterly for PCB migration and groundwater surface elevation. Flow rate and direction shall be determined annually.

2. Inspections and Maintenance

Final surface inspections shall be performed annually for the entire 30-year period to locate deteriorated areas in need of patching.

Inspection of the internal monitoring wells for groundwater level changes and peripheral wells for proper functioning shall occur quarterly for the first five years and annually thereafter.

E. Parking Lot Containment Area

1. Groundwater Monitoring

The ten monitoring wells in this area shall be monitored for PCB migration, groundwater surface elevation, and flow rate and direction. See Sheet No. 536 and Table 2 for well locations. Wells should be monitored quarterly for PCB migration and surface elevation. Flow rate and direction shall be determined annually.

2. Inspections and Maintenance

Final surface inspections shall be performed annually for the entire 30-year period to identify any deteriorated areas in need of patching.

Inspection of the internal monitoring wells for groundwater level changes and peripheral monitoring wells for proper functioning shall occur quarterly for the first five years and annually thereafter.

IV. LAND USE

The land shall be used in such a way as to prevent disturbance of the final cover, liners, monitoring facilities, etc. Land use must not pose a potential health hazard.

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APPENDIX A

CONSTRUCTION SCHEDULE

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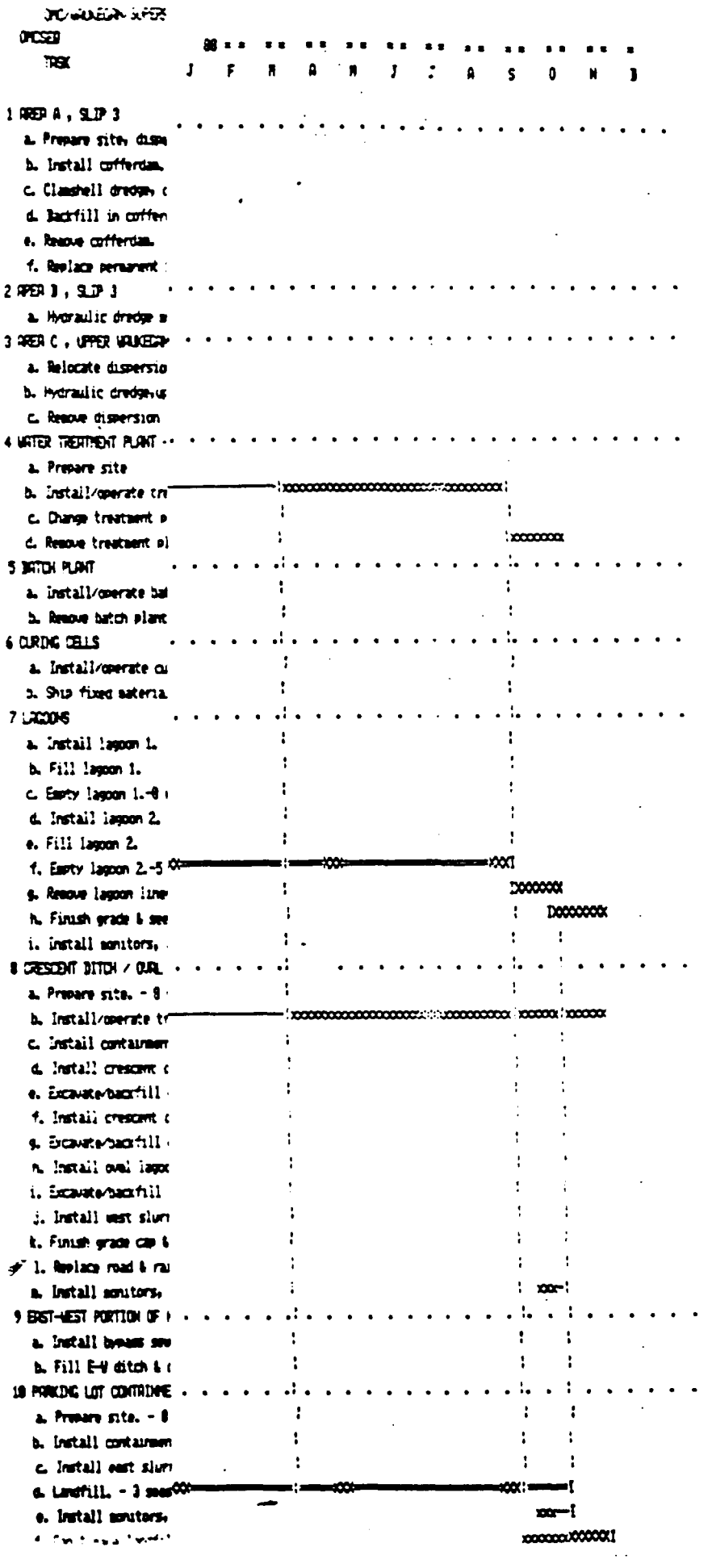
PROJECT
TASK
J F M A M J J A S O N D
1 AREA A , SLIP 3
a. Prepare site, dispo
b. Install cofferdam.
c. Clamshell dredge, c
d. Backfill in coffer
e. Remove cofferdam.
f. Replace permanent
2 AREA B , SLIP 3
a. Hydraulic dredge m
3 AREA C , UPPER MAKEGH
a. Relocate dispersio
b. Hydraulic dredge, u
c. Remove dispersion
4 WATER TREATMENT PLANT
a. Prepare site
b. Install/operate tr
c. Change treatment p
d. Remove treatment pl
5 BATCH PLANT
a. Install/operate bat
b. Remove batch plant
6 CURING CELLS
a. Install/operate cu
b. Ship fixed materia
7 LAGOONS
a. Install lagoon 1.
b. Fill lagoon 1.
c. Empty lagoon 1.-8
d. Install lagoon 2.
e. Fill lagoon 2.
f. Empty lagoon 2.-5
g. Remove lagoon line
h. Finish grade & see
i. Install monitors,
8 CRESCENT DITCH / OVAL
a. Prepare site. - 8
b. Install/operate tr
c. Install containmen
d. Install crescent c
e. Excavate/backfill
f. Install crescent c
g. Excavate/backfill
h. Install oval lagoo
i. Excavate/backfill
j. Install west slurr
k. Finish grade cap &
l. Replace road & ra
m. Install monitors,
9 EAST-WEST PORTION OF
a. Install bypass sew
b. Fill E-W ditch & c
10 PARKING LOT CONTAINME
a. Prepare site. - 8
b. Install containmen
c. Install east slurr
d. Landfill. - 3 seas
e. Install monitors,

APPENDIX B

CONTACT LIST

WARZYN

APPENDIX C

WELL INSTALLATION DETAILS

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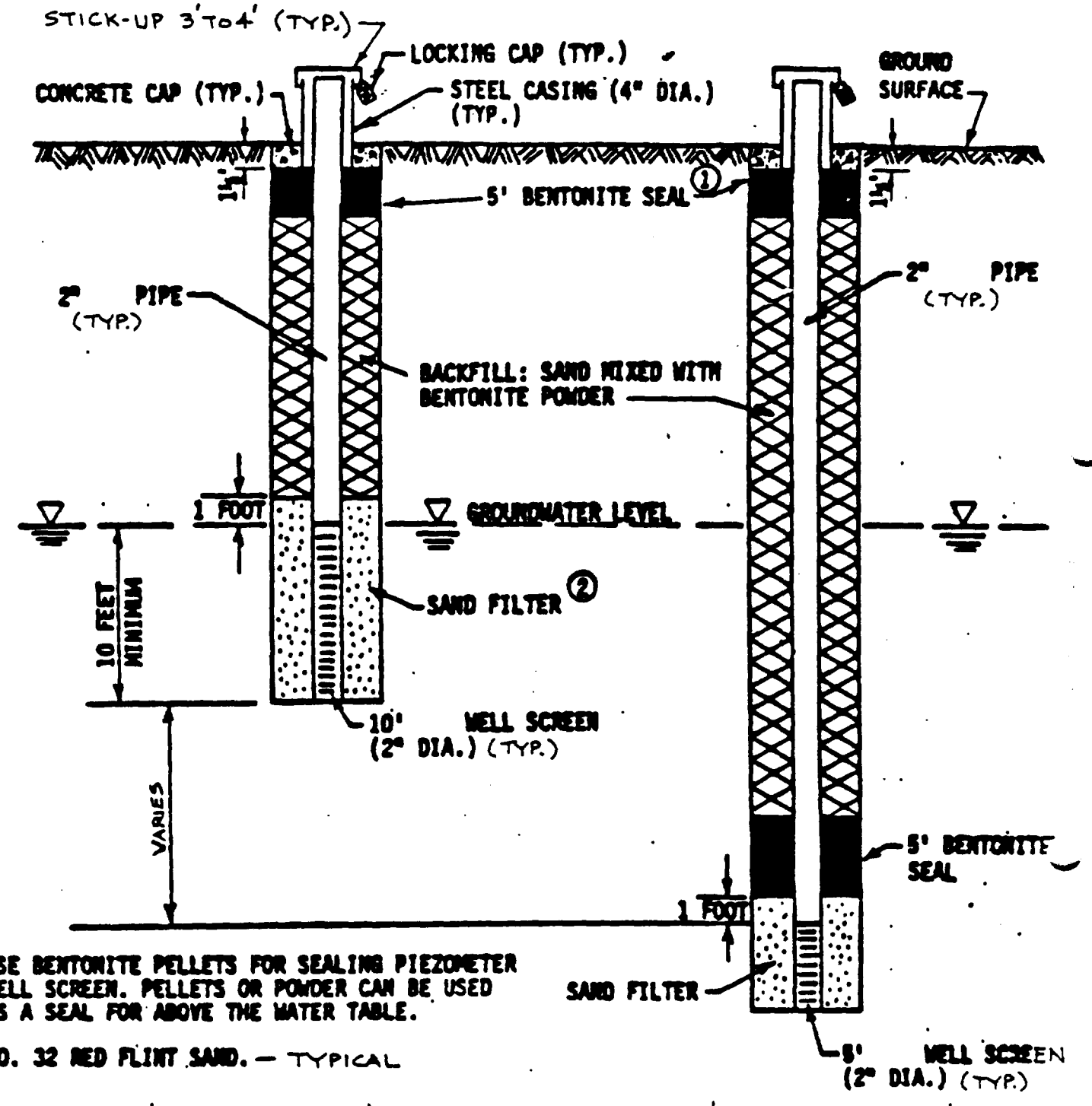
APPENDIX C

WELL INSTALLATION DETAIL



① USE BENTONITE PELLETS FOR SEALING PIEZOMETER WELL SCREEN. PELLETS OR POWDER CAN BE USED AS A SEAL FOR ABOVE THE WATER TABLE.

② NO. 32 RED FLINT SAND. — TYPICAL

SINGLE WELL

NESTED WELL

TYPICAL WELL INSTALLATION DETAIL

NOT TO SCALE

APPENDIX D

WELL MONITORING PROCEDURES

WARZYN

PROCEDURES MANUAL
FOR GROUNDWATER MONITORING

C 10500

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LIST OF TABLES

LIST OF APPENDICES

BJH/cwl
[dkp-232-15]

WARZYN ENGINEERING INC

PROCEDURES MANUAL
FOR GROUNDWATER MONITORING

PLANNING

Following is a list of equipment necessary for groundwater sampling. Make sure to double check the list before leaving for the site.

A. Equipment

1. Groundwater monitoring well location maps.
2. Field recording sheet and chain-of-custody sheet.
3. Clipboard, pencil, marker pen, key to wells, knife.
4. Sample bottles (take extra, see Tables 1 and 2 for list of bottles required for parameters or check field reporting sheet for required bottles).
5. Cooler and ice for storing samples.
6. Fiberglass measuring tape with popper, or electric water level indicator (take an extra).
7. Bailers and rope (take several sizes).
8. Well Wizard and/or hand pump and hose if necessary.
9. Trisodiumphosphate (TSP) to wash sampling equipment (optional).
10. Deionized water to rinse sampling equipment.
11. Protective clothing (rubber gloves, boots, hard hat, safety glasses, etc.).
12. Filtering apparatus (millipore system, filters, hand pump, air tank, compressor, hoses, etc.)
13. Preservatives (as required), hardness indicator.
14. Tools - hammer, channel locks, pipe wrench, screwdriver.

B. Site Location Planning

Plan out the order in which wells are to be sampled. The well order should be in the job file folder for ongoing jobs. Prebail tight wells first. Sample from the least to the most contaminated. Look up previous data to determine previous water quality information to set up sampling schedule. If no previous data is available, sample upgradient wells first and/or request information from the hydrogeologist or project manager.

If more than one team will be sampling wells, decide who will sample which wells to avoid duplication and to be sure that all required wells have been sampled.

BJH/dkp/cwl
[dkp-232-1]

TABLE 1
SAMPLE HANDLING AND PRESERVATION

Parameter	Preservation	Volumes Required (mls)	Container	Holding Time Recommended	Holding Time Maximum
Acidity/Alkalinity	4°C	50	P, G	24 hours	14 days
BOD	4°C	1000	P, G	24 hours	48 hours
Boron	4°C	50	P		
COD	H_2SO_4 to pH<2, 4°C	10	P, G	7 days	28 days
Chloride	4°C	50	P, G	7 days	28 days
Chlorine	None	50	P, G	on-site	on-site
Chromium, Hexavalent	4°C	50	P, G	24 hours	48 hours
Conductivity	4°C	50	P, G	24 hours	28 days
Cyanide, Total & Amenable	NaOH to pH > 12, 4°C	1000	P, G	24 hours	14 days
Dissolved Oxygen	None	100	G	on-site	on-site
Fluoride	None	50	P, G	7 days	28 days
Hardness	4°C	50	P, G	7 days	6 months
MBAS	4°C		P, G	24 hours	48 hours
Ammonia Nitrogen	H_2SO_4 to pH<2, 4°C	50	P, G	24 hours	28 days
Nitrate Nitrogen	H_2SO_4 to pH<2, 4°C	10	P, G	24 hours	48 hour
Nitrite Nitrogen	4°C	50	P, G	48 hours	48 hours
Nitrate & Nitrate	H_2SO_4 to pH<2, 4°C	50	P, G	24 hours	28 days
Organic & Kjeldahl Nitrogen	H_2SO_4 to pH<2, 4°C	50	P, G	24 hours	28 days
Oil & Grease	H_2SO_4 to pH<2, 4°C	1000	G	24 hours	28 days
pH	4°C	50	P, G	6 hours	2 hours
Phenol	H_2SO_4 to pH<2, 4°C	500	G	24 hours	28 day
Phosphorus, Ortho	4°C	50	P, G	24 hours	48 hours
Phosphorus, Total	H_2SO_4 to pH<2, 4°C	50	P, G	24 hours	28 days
Silica	4°C	50	P	7 days	28 days
Solids, Total & Filterable	4°C	100	P, G	7 days	14 days
Solids, Non-Filterable & Volatile	4°C	100	P, G	7 days	7 days
Sulfate	4°C	50	P, G	7 days	28 days
TOC	H_2SO_4 to pH<2, 4°C	100	P, G	24 hours	28 day
Turbidity	4°C	50	P, G	7 days	48 hours
Metals	HNO_3 to pH<2	100	P, G	6 months	6 month
Mercury	HNO_3 to pH<2	100	P, G	13 days	28 days
VOA's	4°C	40	VOA vial	14 days*	14 days*
Organics	4°C	1,000/analyses	Brown glass	7 days*	7 days*

* Until extraction

PVC/dkp/cwl
[dkp-232-11]

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TABLE 2

REQUIRED FIELD PREPARATION
FOR SPECIFIC ANALYSES

Parameters	Sample Bottle Recommended	Field Preparation
Metals:		
Dissolved	250 ml	Filter: 0.45 um Preserve: pH < 2 with HNO_3
Total	250 ml	Preserve: pH < 2 with HNO_3
Private Well Samples	250 ml	Preserve: pH < 2 with HNO_3 Do not filter
Mercury	250 ml	Collect additional 250 ml bottle Preserve: As above
Alkalinity, pH, Conductivity	250 ml	Cool 4°C
Fluoride TDS Hardness Chloride Boron Sulfate Nitrite Phosphate	100 ml (each)	Filter 0.45 um and Cool 4°C
Nitrate COD Ammonia Total Kjeldahl TOC	100 ml (each)	Filter 0.45 um and Preserve pH < 2 with H_2SO_4
Phenols	500 ml	Preserve < 2 with H_2SO_4
Cyanide	1000 ml	Preserve > 10 with NaOH
VOA	2 VOA vials	Cool 4°C
Organics: B/N Extractibles Acid Extractibles PCB's Pesticides	1000 ml/ analyses	Cool 4°C

BJH/cwl
[dkp-232-10]

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SAMPLING

A. Elevation

1. Inspect outside and inside of monitoring well for any damage, etc. Note on Field Observation Sheet (F.O.S.) any observations.
2. Lower tape with weighted popper into PVC pipe.
3. Slowly play out tape from spool until a pop or splash is heard from the well.
4. Slowly move the popper up and down to locate the water level. This is indicated by a splashing pop sound as the weight is splashed on the water surface.
5. Record the depth to water to the nearest 0.01 feet. The elevation is always to be taken from the "high" side of the PVC.
6. Rinse measuring tape with deionized water between wells.
7. An electric water level indicator can be used in place of a tape. Follow same procedure as tape only record depth to water as indicated by indicator.

B. Bailing

For all wells with sufficient recharge, two to three well volumes are removed using the PVC bailer immediately prior to sample collection. Wells which are installed in tight soils are bailed dry at the beginning of the day and the sample is collected later the same day.

The following is an example of the method used to calculate well volumes:

1. Depth to water is 10.0'; well depth is 20.0'.
2. Subtraction indicates 10.0' of water in well.
3. Calculate volume of water (in gallons) contained in well from values below (ft of water x gallons/ft = well capacity in gallons):

Well Diameter (inches)	Gallons of Water Per Foot
2"	0.16
1 1/4"	0.074

4. Remove 2 to 3 well volumes with bailer (PVC or stainless steel) or Well Wizard and record volume bailed.

C. Sample Collection

1. Monitoring Wells

a. Lower bailer down well slowly. Try to avoid mixing or aerating water in the well. Lower just enough to submerge entire bailer. This will minimize air contact with sample.

b. Bail required volume from well as determined by equation.

c. If the well is being sampled for organic parameters, a stainless steel or teflon bailer is required to take the sample. The initial bailing can be accomplished with a PVC bailer as long as the final 4 to 5 bails are taken with a stainless steel bailer.

d. Rinse sample bottles with sample being bailed. It is advisable to label the sample bottle before rinsing (consult labeling section). A wet bottle is very hard to write on.

e. Collect enough sample for analyses. Consult F.O.S. to determine correct sample volume required or check Tables 1 and 2. Always collect enough sample to bring back an unfiltered, unpreserved portion to the laboratory.

1) Inorganic, organic: Fill sample bottle (plastic or glass) completely and cap.

2) VOA: Fill vial completely. Carefully cap and check for air bubbles. If any air is present, remove cap and add more sample, replace cap and recheck for air bubbles.

f. Preserve appropriate bottles, see Tables 1 and 2 for recommended preservatives, or move on to filtering stage.

g. Analyze for pH and conductivity in field if requested and filter sample (Appendices 1, 2, 3 and 4).

h. Complete Field Observation of Samples worksheet and Chain of Custody forms (Appendices 5, 6 and 7).

i. Store samples on ice in coolers.

j. Clean PVC and stainless steel bailers with Milli-Q water or trisodiumphosphate.

k. Rinse bailer with Milli-Q water between wells.

2. Private Wells

a. Label bottle correctly before collecting sample (consult labeling section).

b. Collect sample from a cold, untreated water source before the water passes through any filters or water softeners. If possible, directly off of the pressure tank. Allow water to run for 5 minutes, or until you hear the well pump turn on and off several times. Univer can be used to check for soft water. If the sample turns blue after the addition of the univer, the sample is from a softwater source and should be resampled.

c. Collect enough sample for analysis. Follow same protocol for filling bottles as listed in monitoring well section. If metals analysis is required, collect the sample directly from the tap. Do not pour off from another sample bottle later on.

d. Preserve appropriate bottles, see Tables 1 and 2 for recommended preservatives. Do not filter private wells samples.

e. Analyze for pH and conductivity in field if requested (Appendices 1, 2 and 3).

f. Complete field observation worksheet and chain of custody form (Appendices 5, 6 and 7).

g. Store sample in cooler on ice.

3. Leachate Risers

a. Take elevation with tape designated for leachates only. Follow same procedure as with monitoring wells.

b. Label bottles before collecting the sample.

c. Collect sample using bailer designated for leachate sampling only.

d. Fill appropriate sampling bottles and preserve samples. Preserve samples with care, let sample foam away from you. Cap sample when it's done foaming.

e. Do not filter leachate samples.

f. Analyze for pH and conductivity if required.

g. Store sample in cooler on ice.

h. Thoroughly rinse off all equipment in contact with leachate.

BJH/dkp/cwl
[dkp-232-1]

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FIELD ANALYSIS OF SAMPLES

A. Color

Describe color of sample by using basic descriptions listed below.

black	green
white	red
brown	orange
gray	blue
clear (none)	

Do not use colors such as buff, beige, tan, lavender, etc. Combinations such as red-brown, green-black, etc. may be used. Use modifiers such as light brown or dark gray where appropriate.

B. Odor

Describe odor of sample by using smells described in Table 3. Use modifiers when appropriate. Note: Use caution when testing odors. Do not expose your olfactory/vascular system to airborne hazards.

C. Turbidity

Use the following clarifiers to describe turbidity.

none	increasing
slight	turbidity
moderate	↓
very	

D. Miscellaneous

Note any sediment which settles soon after sampling such as; sand in sample, insect parts in sample, animal parts in sample, plant debris in sample, etc.

BJH/dkp/cwl
[dkp-232-1]

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TABLE 3

LIST OF ODORS ASSOCIATED WITH WATER SAMPLES

Odors	Modifiers
None	Slight
Metallic	Strong
Leachate	Stale
Rotten Egg	Foul
Oily	Sweet
Foul Rotten Meat	Sharp
Iron	
Fecal	
Septic	
Algae	
Fishy	
Decaying Vegetation	
Stale	
Foul	
Mephetic	
Chemical	
Solvent	
Skunky	
Musty	
Mildew	
Green Apples	
Paint Thinner	
Saliferously Sour	

BJH/cwl
[dkp-232-9]

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LABELING

1. It is advisable to label bottle before placing sample in bottle. That will minimize smearing of sample identification on bottle.

2. Include on bottle:

   C Number
   Sample ID
   Date and Time
   Initials of Sampler

3. Preservatives added to bottles must be identified. Use following color-coded dots or abbreviations of preservatives.

   blue - HNO_3
   red - H_2SO_4
   green - Filtered Sample

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[dkp-232-7]

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QUALITY CONTROL

A. Field Duplicates

A field duplicate should be taken from one of the sampling points. Label it as a duplicate but follow the same procedures used on the sample. Usually one duplicate per site is enough. But when more than 20 samples are collected, 2 duplicates should be collected.

B. Field Blanks

Prepare a field blank following the same procedures used for samples. Preserve appropriate bottles as done to samples.

C. Bailer Blank

Fill a bailer with deionized water to check for contamination from the bailer. Pour deionized water from bailer into sample bottles and treat the same as samples.

D. Field Spikes

Prepare a spike to be added to a sample in the lab. Record concentrations of spike added and report to Laboratory Manager. Spike the sample before filtering and preserving. Make sure to have correct volume of sample specified before spiking. Then filter and preserve sample as usual. Make sure to label spiked sample appropriately. Also, collect the sample in triplicate. This will provide a regular, duplicate, and spiked sample from the same well.

E. Trip Blank

Before leaving the laboratory, prepare a trip blank by filling the appropriate bottles with Milli-Q Water. Preserve trip blank in the same manner as a sample would be in the field.

BJH/dkp/cwl
[dkp-232-8]

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APPENDIX 1

pH

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APPENDIX 1

pH

Method: Electrometric

Reference: EPA 1979, Page 150.1

Sensitivity: 0.1 pH unit

Optimum Range: 1-12 pH units

Sample Handling: Determine on-site or within 6 hours.

Reagents and Apparatus:

1. pH meter (Orion 901 or 407A for lab use, Corning 3D or Orion 211 Mini pH meter for field use).
2. Combination electrodes (Orion for lab and field use, Corning for field use).
3. Magnetic stirrer and stir bars (for lab use).
4. Beakers or plastic cups.
5. pH buffer solutions, pH 4, 7, and 10.
6. Deionized water in squirt bottle.
7. All glassware soap and water washed, hot water rinsed 2X, deionized water rinsed 2X.

Calibration:

1. Place electrode in pH7 buffer solution.
2. After allowing several minutes for meter to stabilize, turn calibration dial until a reading of 7.00 is obtained.
3. Rinse electrode with deionized water and place in pH4 or pH10 buffer solution.
4. Wait several minutes and then turn slope adjustment dial until a reading of 4.00 or 10.00 is obtained.
5. Rinse electrode with deionized water and place in pH7 buffer. If meter reading is not 7.00, follow Steps 2-5 again.

Procedure:

1. Calibrate meter using calibration procedure.

2. Pour the sample into a clean beaker or plastic cup.

3. Place a stir bar in the beaker and put on a magnetic stirrer for lab pH. Swirl cup gently for field pH.

5. Rinse electrode with deionized water between samples. Recheck calibration with pH7 buffer solution after every 5 samples.

4. Immerse electrode in solution. Make sure the white KCl junction on side of electrode is in the solution. The level of electrode solution should be one inch above sample to be measured.

Notes:

1. When calibrating the meter, use pH buffers 7 and 4 for samples with pH $\leq$8, and buffers 7 and 10 for samples with pH $\geq$8. If meter will not read pH4 or 10, something may be wrong with the electrode. Return it to the lab with a note.

2. pH is a temperature dependent analysis. Therefore, temperatures of buffers and samples should be within about 2°C. For refrigerated or cool samples, use refrigerated buffers to calibrate meter.

3. Weak organic and inorganic salts and oil and grease are interferences in pH measurements. If oil and grease are visible, note on data sheet. Clean electrode with soap and water, followed by 10% HCl. Then recalibrate meter.

4. When not in use, the electrode should be stored in pH4 buffer.

5. Before going into the field:

   a) Check batteries;
   b) Do a quick calibration at pH7 and 4 to check electrode;
   c) Obtain fresh solutions.

6. Following field measurements:

   a) Report any problems;
   b) Compare with previous data;
   c) Clean all dirt off of meter and inside case;
   d) Make sure electrode is stored in pH4 buffer.

PVC/mlf/cwl
[dkp-232-5]

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APPENDIX 2

CONDUCTIVITY
(YSI METER)

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APPENDIX 2

CONDUCTIVITY
(YSI METER)

Method: Specific Conductance, umhos @ 25°C

Reference: EPA 1979, Page 120.1, Standard Methods, 15th edition, pp 70-73

Detection Limit: 1 umho/cm @ 25°C

Optimum Range: 0.1 - 100,000 umhos/cm

Sample Handling: Determine on-site or within 24 hours

Reagents and Apparatus:

1. Conductivity meter and electrodes or cell (lab-line for lab use, YSI for field use)
2. Deionized water in squirt bottle.
3. Standard potassium chloride solution, 0.0100 N.

Procedure:

YSI Conductivity Meter

1. With mode switch at off position, check meter zero. If not zeroed, use meter screw and adjust to zero.
2. Plug probe into jack on side of meter.
3. Turn mode switch to red line, and turn red line knob until needle aligns with red line on dial. Change batteries if cannot be aligned.
4. Totally immerse and suspend probe into sample. Do not allow the probe to touch the sample container.
5. Turn mode switch to appropriate conductivity scale, X100, X10, or X1. Use a scale that will give a mid-range output on the meter.
6. Wait for needle to stabilize (about 15 sec.) and record conductivity multiplying times scale setting.
7. While gently agitating the probe, take sample temperature (°C) and record.
8. Rinse probe with deionized water.
9. Record specific conductivity (1st column) and temperature on F.O.S. sheet.

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Notes:

1. Calculate conductivity using following formula:

$$G_{25} = \frac{G_T}{[1 + 0.02\ (T-25)]}$$

G_{25} = Conductivity at 25°C, umhos/cm

T = Temperature of sample, °C

G_T = Conductivity of sample at temperature T, umhos/cm

2. Report the standard solution with each data set.

3. Record on field sheet which meter and probe were used. Meter should be wiped clean as necessary.

4. After returning to lab, compare results with previous data. Report problems to lab personnel.

Reagent Preparation:

1. Stock Potassium Chloride Solution, 1.00 N: Dissolve 74.555 g. K Cl in Milli-Q water and dilute to 1,000 ml. in a volumetric flask.

2. Standard Potassium Chloride Solution, 0.0100N: Dilute to 10.0 mls. of stock solution to 1,000 mls. with Milli-Q water using a volumetric pipet and flask.

BJH/dkp/cwl
[dkp-232-3]

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APPENDIX 3

CONDUCTIVITY
(LAB-LINE METER)

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APPENDIX 3

CONDUCTIVITY
(LAB-LINE METER)

Method: Specific Conductance, umhos @ 25°C

Reference: EPA 1979, Page 120.1, Standard Methods, 15th edition, pp 70-73

Detection Limit: 1 umho/cm @ 25°C

Optimum Range: 0.1 - 100,000 umhos/cm

Sample Handling: Determine on-site or within 24 hours

Reagents and Apparatus:

1. Conductivity meter and electrodes or cell (lab-line for lab use, YSI for field use)
2. Deionized water in squirt bottle.
3. Standard potassium chloride solution, 0.0100 N.

Procedure:

Lab-Line Conductivity Meter

1. Turn range selector switch to "test"
2. Hold down "press to read" button while turning black bridge balance control knob until red balance indicator is in center. The control knob should read 1.0. If not, lossen the fixing screw in center of knob with Allen wrench and rotate knob until 1.0 is centered. Retest and repeat until test balances at 1.0.
3. Inspect cell to ensure that it is clean.
4. Connect cell labeled "k = 1.0" to meter.
5. Rinse cell first with deionized water, and then with the sample to be tested.
6. Pour sample into top of cell (12 ml. of sample).
7. Take sample temperature with a thermometer (°C) and record.
8. Turn range selector switch to range desired (10 for deionized water, 10^3 for most groundwater samples).
9. For 10^3 scale, set temperature dial to temperature of sample (°C).
10. Remove thermometer from cell. Record temperature.

11. Hold "press to read" button while turning black bridge balance control knob until red balance indicator is centered.

12. Record conductivity from bridge, multiplying times range selected. On 10^3 scale, record as conductivity @ 25°C, on all others record under G_T.

Notes:

1. Lab-line conductivity meter, 10^3 scale, is the only temperature compensated conductivity reading. For other ranges on the lab-line and for all ranges on the YSI, calculate conductivity using following formula:

$$G_{25} = \frac{G_T}{[1 + 0.02\ (T-25)]}$$

G_{25} = Conductivity at 25°C, umhos/cm

T = Temperature of sample, °C

G_T = Conductivity of sample at temperature T, umhos/cm

2. Check calibration of all meters daily with standard 0.0100 N KCl solution. Have the solution in the field if problems are noted.

3. Record on field sheet which meter and probe was used. Meter should be wiped clean as necessary.

4. After returning to lab, compare results with previous data. Report problems to lab personnel.

Reagent Preparation:

1. Stock Potassium Chloride Solution, 1.00 N: Dissolve 74.555 g. K Cl in Milli-Q water and dilute to 1,000 ml. in a volumetric flask.

2. Standard Potassium Chloride Solution, 0.0100N: Dilute to 10.0 mls. of stock solution to 1,000 mls. with Milli-Q water using a volumetric pipet and flask.

BJH/dkp
[dkp-232-4]

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APPENDIX 4

FIELD FILTERING

WARZYN

APPENDIX 4

FIELD FILTERING

Reference: EPA 1979, Metals 5

Sample Handling: Filter as soon as possible after sample collection

Reagents and Apparatus:

1. 10% HCl solution in a squirt bottle and in a liter plastic bottle.
2. Milli-Q water
3. Plastic forceps
4. Millipore pressure filtration apparatus
5. 0.45 um. membrane filters (142 mm)
6. Compressed air

Procedure:

1. Using plastic forceps, place a 0.45 um. filter on top of blue grid.
2. Place a prefilter on top of membrane filter (when needed).
3. Center the stainless steel cylinder on top of the filters, with the white gasket down.
4. Place top onto cylinder rim. Screw handwheel bolts down until even and snug. Finish tightening with plastic wrench.
5. Attach end of PVC hosing to compressed air source.
6. Using squirt bottle, squirt about 10 to 25 mls. of 10% HCl into top opening. In no metals, a DI rinse may be sufficient.
7. Using the clamp, attach the hose adaptor to the top opening. Tighten clamp.
8. Place beaker under outlet.
9. Slowly pressurize the Millipore apparatus. until flow stops. No leaks should be observed.
10. Shut off compressed air and open release valve.
11. Disconnect top clamp.
12. Pressure rinse with 30-40 ml of sample, following above procedure.

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13. Place clean beaker or sample container under outlet.

14. Add sample and pressure filter, following above procedure.

15. After shutting off air and opening release valve, disconnect clamp and top plate and remove cylinder. Throw filters away.

16. Pour sample into a 100 ml. plastic bottle, label and preserve.

17. Clean Milli-Q filtering apparatus.

Notes:

1. Samples with high sediment can be filtered through several membranes with increasing pore size and several prefilters. The 0.45 um. membrane filter should always be on the grid, and the coarsest filters on the top.

Reagent Preparation:

1. 10% HCl Solution: Add about 900 mls. of Milli-Q water to a one-liter Erlenmeyer flask. Using a graduated cylinder, add 100 mls. concentrated HCL to the Milli-Q water while stirring.

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[dkp-232-2]

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APPENDIX 5

FIELD OBSERVATIONS OF SAMPLES

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FIELD OBSERVATIONS OF GW

JOB NAME: _____ C# _____ PAGE ____ OF _____

LOCATION: _____ SAMPLING DATE: _____ BY: _____

DATE PROCESSED: _____ BY: _____ VOLUME REQUIRED: _____ PROJECT MANAGER: _____

PARAMETERS:

- ☐ pH
- ☐ Conductivity
- ☐ Total Alkalinity
- ☐ Chloride
- ☐ Total Hardness
- ☐ Dissolved Iron
- ☐ Nitrite
- ☐ Sodium
- ☐ Sulfate
- ☐ COD
- ☐ Nitrate
- ☐ TDS

OTHER: _____

LAB #	SAMP.#	TD	T.O.C. ELEV.	DEPTH TO WATER	GW ELEV.	ODOR	COLOR	TURB.	pH* (LAB)	SPEC.* COND. (LAB)	TEMP.* C (LAB)	SPEC. COND. @ 25° C	
-D	-D												
-S	-S												

COMMENTS: _____

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* Measured in field unless otherwise noted.

FORM # _____

APPENDIX 6

FIELD TESTING/SAMPLE PREPARATION

WARZYN

C # _____

Date _____

FIELD TESTING/SAMPLE PREPARATION

Lab #	Sample #	Time Filtered/ Analyzed	pH	Spec. Cond.	Temp.	Spec. Cond. @ 25°	Analyst	Comments
-D								
-D								

pH Meter: _____

Conductivity Meter: _____

Bottle Types/Preservation: _____

Conductivity of Standard: _____

PVC/cwl/mlf
[mlf-160-31]

APPENDIX 7

CHAIN OF CUSTODY

WARZYN

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Engineers & Scientists
Environmental · Geological · Civil · Structural
Geotechnical · Chemical/Materials Testing
Soil Borings · Surveying

1400 EMIL STREET, P.O. BOX 8636, MADISON, WIS. 53716
TEL. (608) 257-4848 WIS. TOLL FREE NO. 800-362-6006

Location _____

C Number _____

CHAIN OF CUSTODY

FIELD:

Sample Description _____

_____

Sampled By: _____ Signature: _____

Date: _____

Number of Bottles/Sample _____

FIELD LAB:

Accepted By: _____ Signature: _____

Condition of Samples: _____

Sample Preparation: _____

_____

_____

SHIPPING INFORMATION:

Carrier: _____ Signature: _____

Date Shipped: _____

ANALYTICAL LAB:

Sample Custodian: _____ Position: _____

Signature: _____

Condition of Samples _____

Date Received: _____

[las-33-30]

APPENDIX E

WELL ABANDONMENT PROCEDURES

WARZYN

APPENDIX E

WELL ABANDONMENT PROCEDURES

All monitoring wells that are scheduled to be removed shall be abandoned in the following fashion:

1. Any existing steel casing shall first be removed by vertically pulling it off the existing monitoring location.

2. The PVC well casing shall then be overdrilled with hollow stem augers at suitable inside diameter to allow the augers to be advanced past the bottom of the existing monitoring well to the maximum depth of the previously drilled test boring.

3. The monitoring well pipe shall then be extracted, if possible, from the hollow stem auger and the interior of the hollow stem augers shall be cleaned of drilling debris by advancing the central coring plug through the hollow stem augers to the maximum depth that the augers have been extended.

4. As the hollow stem augers are extracted in 5-foot increments, the resulting borehole shall be grouted with a cement/bentonite grout.

5. After 24 hours, the cement/bentonite grout shall be "retopped", if necessary, to completely fill the borehole to the existing ground surface.

6. The removed protective casing and well pipe can be salvaged, if desired, by proper decontamination procedures or be disposed of in the parking lot containment cell.

LAB/dkp
[dkp-230-6]